

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY
Piedmont Regional Office
INTRA-AGENCY MEMORANDUM
Engineering Analysis

Permit Writer	Alison Sinclair
Air Permit Manager	James Kyle
Memo To	Air Permit Files
Date	February 4, 2020
Facility Name	Dominion Brunswick County Power Station
Registration Number	52404
Application No.	5
Date Fee Paid	October 9, 2015
Amount (\$)	\$7,349
Distance to SNP (km)	>100 km
Distance to JRF (km)	>100 km
FLM Notification (Y/N)	N
Application Fee Classification	Title V

Permit Writer Signature



Permit Manager Signature

I. Introduction

The Dominion Brunswick County Power station received its initial PSD permit to construct and operate on March 12, 2013. At the time of the issuance of that permit, alternative operating scenarios for combustion turbines, such as tuning and online turbine blade washing had not been developed.

Dominion originally submitted an application to DEQ on October 7, 2015 to update some of the language in the original PSD permit and to add alternative operating scenarios such as turbine tuning and water washing. A letter of determination was sent by DEQ to Dominion on December 16, 2015 and stated that the proposed changes to the permit would be considered a significant amendment to their PSD permit. Dominion advertised a notice in a local newspaper on January 6, 2016 and held a public briefing, as required by 9 VAC 5-80-1775, on February 9, 2016. Meanwhile, the facility had commenced startup on December 3, 2015.

During subsequent months of drafting the amendment to the Brunswick PSD permit, DEQ and Dominion discussed several options for including maintenance activities and possible equipment changes. Meanwhile, the PSD permit for the Greensville County Power Station (52525) was drafted and issued on June 17, 2016. That permit had numerical emission limitations for NO_x and CO during periods of tuning and water washing.

Dominion requested time to re-evaluate what was being requested for the Brunswick amendment to make it consistent with the Greenville determinations. On April 9, 2019, Dominion submitted a revised application. Dominion is seeking to include alternative emission limits for the Brunswick plant during tuning and online water washing.

Also, some minor clarifications, corrections, and streamlining of conditions will be included.

Brunswick County is in attainment for all pollutants and is not located in an ozone maintenance area (as listed in 9 VAC 5-20-203).

II. Emission Units / Process Description

The facility is a natural gas-fired combined cycle power plant. Dominion is proposing to include alternative emission limits for maintenance activities such as turbine tuning and turbine blade water washing.

Alternate Operating Scenarios: The permittee requests to be allowed two maintenance events requiring alternate operating scenarios for the CTs, i.e., turbine tuning and turbine blade water washing.

A. Turbine tuning

Turbine tuning consists of adjusting the air-to-fuel ratio under a wide range of load and atmospheric conditions in order to optimize turbine performance, while minimizing emissions. On a periodic and as-needed basis, planned maintenance of the turbine blades shall include tuning of the turbines. A tuning event could last up to 18 hours. During tuning, the turbines might not be able to meet the lb/hr or other short-term emission limits on a three-hour average (or one-hour average for NO_x) due to fluctuations in airflow and fuel flow during tuning. The permittee requests an alternate timeframe of a 24-hour calendar day to meet the short-term NO_x and CO limits during these events (units would be lb/turbine/day derived from the normal short-term limit extended over the 24-hour calendar day). A maximum of 96 hours per year per turbine will be utilized for this maintenance.

B. Water washing of turbine blades

When the turbine blades become dirty over time, the efficiency of the turbine declines, so it is necessary to wash the blades on a periodic basis. Water washing involves spraying water into the turbine while it is operating. No more than 60 minutes per event per turbine is allowed. This process could temporarily disrupt the combustion characteristics of the turbine and affect the inlet concentrations of NO_x and CO to a point where it would not be expected to meet the normal lb/hr or other short-term emission limits over a three-hour averaging period (or one-hour average for NO_x). The turbines could meet the lb/hr emission limit over a longer time period. The permittee requests an alternate timeframe of a 24-hour calendar day to meet the short-term NO_x and CO limits during these events (units would be lb/turbine/day derived from the normal short-term limit extended over the 24-hour calendar day). A maximum of 52 hours of water wash events would be needed to accomplish this maintenance.

During these maintenance activities, the air pollution control equipment may be functioning normally, however the CEMS for NO_x and CO may detect a slight increase in hourly emissions for several minutes due to the fluctuation in turbine exhaust temperature or load, causing the normal 1-hr NO_x or 3-hr CO averages to be exceeded. Since BACT must apply at all times, alternative BACT emission limits for NO_x and CO will be added to the permit for these maintenance activities.

III. Regulatory Review

A. 9VAC5 Chapter 80, Part II, Article 6 – Minor New Source Review

Emissions subject to Major New Source Review (Article 8 – PSD) are not subject to Article 6 New Source Review as per 9 VAC 5-80-1100H. In the original permit, only lead was not subject to PSD permitting but at an uncontrolled potential to emit of 0.02 tons/year, lead was exempt from Article 6 Minor New Source Review permitting.

The facility is not a minor source and all other criteria pollutants emitted from the facility are subject to PSD permitting (see III.B below).

B. 9VAC5 Chapter 80, Part II, Article 8 and Article 9 – Major New Source Review

There is no modification proposed for any equipment at this facility. The requested changes did not cause any of the previously determined BACT emission limits to be re-evaluated so this would not trigger PSD permitting. However, the inclusion of alternative emission limits for the proposed alternative operating scenarios of the turbines would be considered a relaxation of emission limits and would require a case-by-case determination of an emission limitation. This permit action is considered a significant amendment to a PSD permit (9VAC 5-8-1955.A.2).

As discussed in Section II above, alternative lb/turbine/day emission limits for NO_x and CO during tuning and water-washing events are necessary during those events. Each of the turbines can emit about 25.2 lbs/hour of NO_x (2.0 ppmvd as a one-hour average) and 17.3 lbs/hour of CO (2.4 ppmvd as a three hour average) in a “normal” hour, with duct firing.

The proposed limits during tuning and water washing are 604 lbs/turbine/day for NO_x and 416 lbs/turbine/day for CO. These values are precisely 24 times the normal emission limit. This methodology of determining emission limits during these events is almost identical to the Dominion Greensville facility, the C4GT facility, and the Chickahominy facility.

NO_x limit during tuning and water washing: $25.17 \text{ lb/hr} \times 24 \text{ hours/day} = 604 \text{ lbs/day}$

CO limit during tuning and water washing: $17.34 \text{ lb/hr} \times 24 \text{ hours/day} = 416 \text{ lbs/day}$

No changes to the annual emission limits for the combustion turbines are requested. The source will need to track the duration of each of these maintenance activities and the total duration of all these activities on a 12-month rolling total basis.

The other changes to the permit, i.e. corrections and clarifications, would be administrative in nature and would be considered administrative amendments to the permit. Administrative

amendments, by themselves, do not trigger public participation requirements. These changes will be incorporated into the draft permit.

C. 9VAC5 Chapter 80, Part II, Article 5 – State Operating Permit (SOP)

This facility operates under an Article 8 PSD permit and does not require a State Operating Permit for enforceable limits.

D. 9VAC5 Chapter 50, Part II, Article 5 – NSPS

No new NSPS requirements are triggered for the inclusion of maintenance activities.

E. 9VAC5 Chapter 60, Part II, Article 1 – NESHAPS

This facility is not subject to any NESHAPS.

F. 9VAC5 Chapter 60, Part II, Article 2 – MACT

This facility is an area source for MACT applicability. This project does not result in any changes to MACT applicability.

G. State Only Enforceable (SOE) Requirements (9VAC5-80-1120 F)

The emission limits for toxic air pollutants in the PSD are considered State Only Enforceable. During the review of the permit for this permit action, it was noted that the SOE conditions in the original permit included a lb/hr limitation for cadmium. This was a transcription error from the emission spreadsheet. The hourly cadmium emissions, at 0.011 lb/hr are exempt from permitting because they are below the exemption rate for cadmium of 0.033 lb/hr. The hourly emission rate for cadmium will be removed from the table in Condition 73.

H. 9VAC5 Chapter 40, Part II, Existing Sources - Emission Standards

This facility is not an existing facility and is subject to BACT requirements, which are more stringent than the limits in Chapter 40.

IV. Best Available Control Technology Review (BACT)

PSD BACT: Sources that are subject to PSD permitting, must apply BACT to those pollutants that triggered PSD permitting. The determination of BACT for PSD permitting usually involves a top-down method:

Step 1 – Identify all possible control technologies;

Step 2 – Eliminate technically infeasible options;

Step 3 – Rank the technically feasible control technologies based upon emission reduction potential;

Step 4 – Evaluate ranked controls based on energy, environmental, and/or economic considerations; and

Step 5 – Select BACT.

The inclusion of alternative emission limits during maintenance events (i.e., tuning and water washing of the turbines) requires a BACT analysis since the facility is requesting a relaxation of

the “normal” emission limits that were determined to be BACT for normal operation of the combustion turbines.

A. BACT for tuning consists of the following:

1. GHG - No alternate BACT was proposed since the BACT limit could be met during tuning.
2. NO_x - Technically feasible NO_x controls during tuning include SCR, DLN, and good combustion practices. Of these, SCR is most effective, followed by good combustion practices and DLN. A combination of these controls will be employed to minimize NO_x during tuning. These requirements are in Condition 1 of the PSD permit. NO_x emissions will be limited to 604 lbs/turbine/calendar day during tuning (Condition 40b).
3. CO - Technically feasible CO controls during tuning include oxidation catalyst, DLN (which can result in lowering CO as well as NO_x), and good combustion practices. Of these, oxidation catalyst is most effective, followed by good combustion practices and DLN. A combination of these controls will be employed to minimize CO during tuning. These requirements are in Condition 4 of the PSD permit. CO emissions will be limited to 416 lbs/turbine/calendar day during tuning (Condition 40b).
4. SO₂ - No alternate BACT was proposed since the combustion of low sulfur fuel will remain BACT during tuning.
5. VOC - Although VOC controls would be similar to CO controls, the effectiveness of these controls could be minimal. VOC from the turbines is controlled by oxidation catalyst and good combustion practices (Condition 6). Dominion did not propose an alternative emission limitation for VOC emissions during tuning events, however, limitations on the duration of tuning events and limitations on the annual hours of operation for this type of event in Condition 12 will minimize VOC emissions.
6. PM - Add-on controls for PM, like electrostatic precipitators or baghouses are usually not applied to natural gas plants, especially for alternative operating scenarios such as tuning. A feasible control for PM would be the use of clean fuel, such as natural gas, followed by good combustion practices. These requirements are in Condition 9 of the PSD permit. Dominion did not propose alternative emission limitations for PM during tuning events, however, the limitations on the duration of tuning events and limitations on the annual hours of operation for this type of event in Condition 12 will minimize PM emissions.

B. BACT for water washing consists of the following:

1. GHG - No alternate BACT was proposed since the BACT limit could be met during water washing.

2. NO_x - Technically feasible NO_x controls during water washing include SCR, DLN, and good combustion practices. Of these, SCR is most effective, followed by good combustion practices and DLN. A combination of these controls will be employed to minimize NO_x during water washing. These requirements are in Condition 1 of the PSD permit. NO_x emissions will be limited to 604 lbs/turbine/calendar day during water washing (Condition 40b).
3. CO - Technically feasible CO controls during water washing include oxidation catalyst, DLN (which can result in lowering CO as well as NO_x), and good combustion practices. Of these, oxidation catalyst is most effective, followed by good combustion practices and DLN. A combination of these controls will be employed to minimize CO during water washing. These requirements are in Condition 4 of the PSD permit. CO emissions will be limited to 416 lbs/turbine/calendar day during water washing (Condition 40b).
4. SO₂ - No alternative BACT was proposed since the combustion of low sulfur fuel will remain BACT during water washing.
5. VOC - Although VOC controls would be similar to CO controls, the effectiveness of these controls could be minimal. VOC from the turbines is controlled by oxidation catalyst and good combustion practices (Condition 6). Dominion did not propose an alternative emission limitation for VOC emissions during water washing events, however, limitations on the duration of these events and limitations on the annual hours of operation for this type of event in Condition 12 will minimize VOC emissions.
6. PM - Add-on controls for PM, like electrostatic precipitators or baghouses are usually not applied to natural gas plants, especially for alternative operating scenarios such as water washing. A feasible control for PM would be the use of clean fuel, such as natural gas, followed by good combustion practices. These requirements are in Condition 9 of the PSD permit. Dominion did not propose an alternative emission limitation for PM emissions during water washing events, however, limitations on the duration of these events and limitations on the annual hours of operation for this type of event in Condition 12 will minimize PM emissions.

Alternative emission limits for these alternative operating scenarios are a relatively recent addition to some permits and the RACT, BACT, LAER Clearinghouse does not have a convenient way of listing these limits so such data is hard to retrieve from that system (if it is even in it). A comparison of recent permits issued in Virginia was done. In each case, the NO_x and CO lb/turbine/day limits reflect the “normal” hourly emission rate of those pollutants over a 24-hr day. This is the same methodology used to estimate the lb/turbine/day limits during tuning and water washing for similar facilities (see Section II above).

A review of recently issued permits from other states turned up a couple more determinations for tuning. The majority of permits that referenced tuning acknowledge tuning as an important part of turbine maintenance, especially as it pertains to energy efficiency and minimizing CO₂. However,

those permits do not offer alternative BACT limits during those periods, but rather exclude such emissions from compliance with the normal BACT limits for the turbines. In some cases, at a minimum, a permit may require the tracking and reporting of excess emissions from the turbines, which might occur during events such as tuning and water washing, although not explicitly stated in the permit for those events.

Table 1 below lists permitted facilities with alternative BACT limitations during tuning and/or water washing (sorted by the lb/hr NOx limit):

Table 1 - Comparison of Permitted BACT values

Facility (permit year)	Pollutant and BACT limitations
C4GT, LLC, VA (tuning or water washing) Siemens turbines without duct burning. (2018)	Duration of tuning event limited to 18 consecutive hours per event. Duration of water wash event limited to 60 minutes per day per turbine. No annual limits on tuning or water washing events but emissions cannot exceed annual permit emission limits. NOx: 564 lb/turbine/calendar day (23.5 lbs/hr) CO: 309 lb/turbine/calendar day (12.9 lbs/hr)
Dominion Greensville, VA (tuning or water washing) Mitsubishi turbines with duct burning. (2016)	Duration of tuning event limited to 18 consecutive hours per event. Annual tuning limited to 96 hours/year for each turbine. Duration of water wash event limited to 60 minutes per day. Annual washing limited to 52 hours/year for each turbine. NOx: 648 lb/turbine/calendar day (27 lbs/hr) CO: 436 lb/turbine/calendar day (18.2 lbs/hr)
Chickahominy Power, VA (tuning only) Mitsubishi turbines without duct burning. (2019)	Duration of tuning event limited to 18 consecutive hours per event. Annual tuning duration limited to 96 hours/year for each turbine. NOx: 703 lb/turbine/calendar day (29.2 lbs/hr) CO: 214 lb/turbine/calendar day (8.9 lbs/hr) VOC: duration of tuning limited to 18 consecutive hours PM, PM ₁₀ , PM _{2.5} : duration of tuning limited to 18 consecutive hours
Washington Parish Energy Ctr, LA (startup/shutdown/maintenance/tuning/runback) (2018)	Simple Cycle unit. NOx – 86.38 lb/hr CO – 800.08 lb/hr PM ₁₀ /PM _{2.5} – 6.3 lb/hr
Jackson Energy Ctr, IL (2018)	NOx limit during tuning is 91.5 lbs/hr (1-hr average). CO limit during tuning is 239 lb/hr.
Invenergy Nelson Expansion, IL (commissioning and tuning) (2016)	Tuning is limited to no more than 25 hrs/yr. During commissioning and during tuning of a turbine on natural gas, NOx emissions shall not exceed 106.7 lbs/hr and 15

Facility (permit year)	Pollutant and BACT limitations
	ppmvd at 15 percent O ₂ .
CPV Three Rivers Energy Ctr, IL (2018)	Per turbine, natural gas firing, 3-hr avg: NO _x during tuning – 228 lbs/hr CO during tuning: 204 lbs/hr
Palomar Energy Ctr – CA (startup, shutdown, low load, tuning)(2016)	Total combined emissions from two units NO _x - 400 lb/hr (1-clock-hour period) CO – 2,000 lb/hr (1-clock-hour period)
Panda Stonewall, LLC, VA (re-tuning event) (2013)	Duration of retuning event limited to 12 hours/24-hr period. Excess NO _x emissions from tuning shall be reported in the semi-annual report.
FPL Dania Beach (2017)and FPL Okeechobee (2016) - FL	During DLN tuning, the requested NO _x limit and BACT GHG emission limits do not apply. During these events, the NO _x limit in NSPS KKKK [15 ppm@ 15% O ₂] and the GHG limit in NSPS TTTT [1,000 lb/MWh] apply. The BACT limit for CO [4.3 ppmvd @15% O ₂ at greater than or equal to 90% load or 7.2 ppmvd @ 15% O ₂ at less than 90% load] applies at all times.

The short-term emission limits proposed during maintenance activities (tuning and water washing) for the Brunswick turbines (with duct burning) in Condition 40.b of the draft permit are consistent with the lowest BACT determinations made for similar, recently permitted power plants in Virginia. The proposed limits, on a 24-hr total, are the lowest for a natural gas-fired turbine w/duct burner.

The proposed amendment to the Dominion Brunswick plant will be to add language that defines and limits the duration of tuning and water washing events (using the same language as that found in other permits), as well as to add alternative short-term emission limitations for these events (based on the hourly emissions from the turbine but extended over a 24-hour period). The NO_x limit for each turbine during a tuning or water washing event will be 604 lbs/turbine/calendar day and the CO limit will be 416 lbs/turbine/calendar day. Compliance will be based on CEMS data. No alternative emission limits will be allowed for other air pollutants during tuning or water washing for the turbines at the Dominion Brunswick Plant, however the facility must track the total annual hours of operation for each operating scenario to limit such emissions during those events on an annual basis.

V. Summary of Potential Emissions Increase

There is no increase in annual emissions from the turbines due to the inclusion of alternative short-term emission limits for NO_x and CO during tuning and water-washing.

VI. Dispersion Modeling

A. Criteria Pollutants

Modeling was done for the original PSD permit using the worst-case emissions from all operating scenarios. The proposed changes to the permit do not change the worst-case emissions. On a lb/hr basis, the emissions during normal operation and during maintenance activities is the same. Worst-case emissions for modeling included emissions from startup and shutdown, which are not changing. Additional modeling is not needed.

B. Toxic Pollutants

Modeling was done for the original PSD permit using the worst-case emission from all operating scenarios. The proposed changes to the permit do not change the worst-case emissions from the turbines.

The elimination of the hourly cadmium limit does not actually change the expected hourly cadmium emissions, which are based on fuel usage (which is not changing). Additional modeling is not needed.

VII. Boilerplates and Boilerplate Deviations

The most current boilerplates were used to draft this permit amendment, as well as more-recently issued PSD permits for similar facilities.

VIII. Compliance Demonstration

NO_x and CO are continually monitored with CEMS. That is not changing for this significant amendment. However, the facility must now track the duration and frequency of tuning and water washing events for the turbines, including date and times. The NO_x and CO CEMS must be operational during these events, as well as the SCR and Oxidation Catalyst controls. Compliance with the NO_x and CO limits for tuning and water washing in Condition 40.b will be determined by CEMS.

Additionally, the facility has completed all of their initial testing requirements and were found to be in compliance with their current permit emission limitations. These initial testing conditions are now obsolete and they are being removed from the permit to streamline requirements.

Testing requirements to demonstrate continuing compliance for VOC, PM₁₀, and PM_{2.5} were not included in the original permit. The Title V permit, when issued later in 2020, will require periodic monitoring for all pollutants subject to BACT to fulfill Part 70 requirements to ensure continuing compliance with the emission limits for the turbines and associated duct burners.

IX. Title V Review – 9VAC5 Chapter 80 Part II Article 1 or Article 3

As a major, fossil fuel-fired power plant, the facility will be subject to Article 3 permitting (Acid Rain and Title V requirements). The initial Article 3 Title V application was received on December 2, 2016 and the permit will be combined with the Acid Rain permit, which was issued on March 25, 2014 and renewed by application on October 10, 2019. The changes proposed for this significant amendment will be included in the Title V permit that is currently being drafted.

X. Public Participation and Notifications

Significant amendments to PSD permits are subject to a public comment period of 30 days, followed by a public hearing (9 VAC 5-80-1955.C).

XI. Other Considerations

A. File Consistency Review:

This permit action will add a new emission limit to an existing PSD permit. The previous permit was updated to the newest boilerplate and to be more consistent with other recently-issued permits.

B. Confidentiality:

The application and permit do not contain any confidential information and the source did not request that any information be held confidential.

C. Permit History:

This facility has a single PSD permit and is subject to Article 3 Title V permitting.

March 12, 2013 – (superseded) Original PSD permit for a 3-on-1 natural gas-fired combined cycle combustion turbine electric generating facility.

March 25, 2014 – initial Acid Rain permit

January 28, 2015 – (superseded) Revise PSD permit that reflects the “as-built” configurations of the ancillary equipment and includes maximum startup/shutdown duration and frequency restrictions rather than annual averages.

May 13, 2015 – Significant amendment to the PSD permit to add lead emissions from the auxiliary boiler and fuel gas heaters, which were mistakenly omitted from the permit, and to allow the facility alternative means of showing compliance with CO₂-e emissions, as per 40 CFR Part 75, Appendix G (equation G-4).

October 10, 2019 – Acid Rain permit renewal application received. This acts as the application and permit shield until the Acid Rain permit is combined with the Title V permit.

XII. Recommendations

Approval of the draft permit for the proposed project is recommended.

Attachments

Emission spreadsheet

PSD Permit applicability for 52404 Dominion Brunswick project.

Pollutant	Original Potential to Emit (TPY)*	New Potential to Emit (TPY)	Net Emissions Change (TPY)	PSD Significance Rate (TPY)**	PSD Required?
PM10	216.73	216.73	0.00	15	No
PM2.5	216.36	216.36	0.00	10	No
NOx	341.86	341.86	0.00	40	No
CO	598.56	598.56	0.00	100	No
SO ₂	50.93	50.93	0.00	40	No
VOC	335.72	335.72	0.00	40	No
CO ₂ e	5,322,124	5,322,124	0.00	75,000	No
Lead	0.0223	0.02	0.00	0.6	No
H ₂ SO ₄	30.39	30.39	0.00	7	No

* See January 28, 2015 permit for Original PTE

**PSD significance values from definition of “significant” in 9 VAC 5-80-1615C